PELVIC REPOSITIONING IN LOW BACK PAIN PATIENTS

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Introduction

As mechanical shock and vibration environments evolve, it is important to understand their potential effect on human operators with complex biomechanical characteristics comprised of passive and active mechanical components of varying mass, damping, stiffness, and actuation characteristics. Because the lumbar spine can exhibit local, short-column buckling, stability of the seated human depends on postural control of the pelvis and trunk.[1-2] The ability to sense the position of body parts in space depends on higher-order integration of proprioceptive, vestibular and visual information. Mechanoreceptors in the skin, muscles and joints can all contribute to proprioception.[3] Limb repositioning has long been used to study the mechanisms of proprioception.[4] We have been evaluating the ability of seated low back pain patients to reposition their pelvis. The results have implications for isolation design and standards development.

Methods

Using electromagnetic position and orientation sensors attached to the skin over T1, L1, L3, and S1, 66 low back pain patients (41 women, 25 men; 91% low back pain duration > 1 year) were evaluated for their ability to reposition their pelvis while seated, without a backrest, hands crossed on their chest, on a small platform that could rotate about a transverse axis approximately aligned with the centers of rotation of the patient's femoral heads. Each patient was instructed to locate a pelvic target position, tilt their pelvis either forward or backward for 3 cycles, and then return to the target positions.

Test Abbreviation	Target Position	Movement Initiation
NF=	Neutral (self-selected)	Forward
FF =	Forward	Forward
FB =	Forward	Backward
BF =	Backward	Forward
BB =	Backward	Backward
NF =	Neutral	Forward
NB =	Neutral	Backward

Blindfolded, each patient accomplished the repositioning task using the six combinations of target position and direction of movement initiation listed in the Table. Accuracy of repositioning was assessed by changes in the length of the spine from S1 to T1 (mm), horizontal location of the T1, L1 and L3 sensors with respect to the sacrum (mm), and lumbar flexion angle (deg) were calculated.

Results

The mean error (difference between initial and final positions for each test) was normalized by the difference between the mean maximum and mean minimum movements for each outcome. This was averaged across all six pelvic repositioning tests (NF, FF, FB, BF, BB, NF, NB). No tests for significance differences have been conducted. Measurements on 66 individuals indicates that the standard deviation exceeds the mean of the error.

Normalized errors	Error/(Max-Min) Average across movements
Length of Spine error S1 to T1	0.070
T1 horizontal position error with respect to Sacrum	0.076
L1 horizontal position error with respect to Sacrum	-0.006
L3 horizontal position error with respect to Sacrum	-0.047
Lumbar Flexion Angle error	0.046

Discussion

In this pilot study, a method was explored for evaluating the ability of low back pain patients to reposition their pelvis. Sixty-six of a planned sample size of 200 patients have been evaluated before treatment for low back pain. Although not evaluated for statistical significance, the normalized errors of motions were less than 8%, with the position of L1 with respect to the sacrum having the lowest normalized error. Insight developed from work like this will help determine the importance of considering control of posture in static or vibrating, seated conditions. There are several limitations of the described dataset: it represents only individuals with low back pain, data are still being collected, and only descriptive statistics have been evaluated.

Acknowledgements Under the leadership of Dr. Joel Pickar, this project entitled: *Effect of Spinal Manipulation on Sensorimotor Functions in Low Back Pain Patients,* was supported by Grant Number U19 AT004137 from the National Center for Complementary and Alternative Medicine (NCCAM). This investigation was conducted in a facility constructed with support from Research Facilities Improvement Program Grant Number C06 RR15433-01 from the National Center for Research Resources, NIH.

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